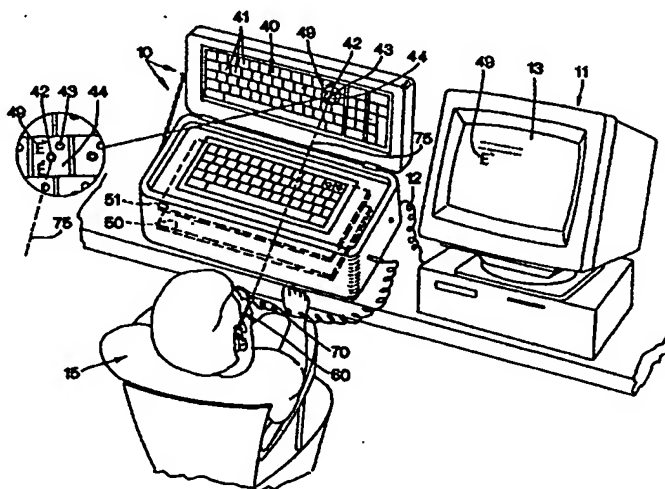


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(54) Title: **OPTICAL KEYBOARD FOR A PERSONAL COMPUTER ACTIVATED BY A LIGHT EMITTING DEVICE WORN ON A HANDICAPPED USER'S HEAD**

**(57) Abstract**

Instrument (10) comprising a squared board (40) on which are squares (41, 44) corresponding to the keys of ordinary keyboards of a computer (11), each provided with a phototransistor (42) that by means of electronic circuits comprising an electronic motherboard (50) equivalent to that associated to the keys of ordinary keyboards for computers (11), connected through an electronic daughter board (51), upstream to the squared board (40) and downstream to the computer (11), transmits to this latter pulses equivalent to those that it would receive by compression of the keys corresponding to said squares (41, 44), as soon as the phototransistors (42) receive a beam (75) of concentrated light from an emitter (70) fixed to a device (60) that can be worn like spectacle frames on the head of a handicapped person (15).

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**OPTICAL KEYBOARD FOR A PERSONAL COMPUTER ACTIVATED BY A LIGHT EMITTING DEVICE WORN ON
A HANDICAPPED USER'S HEAD**

The invention concerns electronic equipment for working computers
15 and the like by merely moving the head.

Several types of keyboards have been devised for persons suffering from different forms of handicap.

Particularly well known is a kind of headset with a stick on its front that can be used to press the keys of a computer keyboard by a
20 movement of the person's head.

The headset is made of light material and leaves the field of vision entirely free.

The stick is adjustable in length and can be replaced by a pen or a paintbrush with which to write or paint.

25 This system and others however create considerable problems both because it may be tiring for a handicapped persons even to make the head movements needed to press the keys, and also because such movements to work the stick may be thought humiliating.

The present invention makes it possible to work the computer by
30 only slight head movements both practical and easy for a handicapped person as will be explained below.

Subject of the invention is an instrument that generates means for

operating a computer, equivalent to those of an ordinary keyboard, comprising a squared board each square on which corresponds to a computer key.

In each square there is a phototransistor which, by means of
5 specially made electronic circuits, transmits a pulse to the computer equivalent to the one it would receive when the key corresponding to that square is pressed, this happening as soon as the phototransistor concerned receives a ray of concentrated light from an emitting device worn on the head of the handicapped person
10 somewhat similarly to a pair of spectacles.

In each square is a coloured LED that lights up when the ray of concentrated light coincides with the phototransistor, telling the handicapped person that the pulse has been duly received.

The electronic circuits consist of a motherboard like that used for an
15 ordinary computer keyboard, electronically connected upstream to the photosensitive squared board and downstream to the computer. Between the motherboard and the photosensitive squared board there is a daughter board with all the circuits needed for generating signals between the various phototransistors placed in the squares
20 of the photosensitive board and the computer circuits corresponding to the keys of an ordinary keyboard.

A keyboard substantially equivalent to an ordinary computer keyboard is associated to the photosensitive squared board, in which each key is electronically connected both to the photosensor in a
25 square of the photosensitive squared board and to the circuits that transmit pulses to the computer, the purpose of this being to enable a helper to assist the handicapped person, especially in the learning stages, to correct any errors or overcome any difficulties.

Structurally the instrument consists of a case with a cover, or lid,
30 the auxiliary keyboard being situated on the upper surface of the case and the photosensitive squared board in the lid, while the

mother and daughter boards, with circuits for connection to the computer, are placed under the auxiliary keyboard inside the case.

The above lid is hinged to the case on one of its longer sides so that the photosensitive squared board, inside said lid, can be inclined as desired in relation to the upper surface of the case, said
5 desired inclination being stabilized by an adjustable means.

This adjustable means consists of a chain fixed at one end to a pin on the lid and, at the other end, to a pin on the side of the case close to its upper surface, it being possible by inserting this second
10 pin in one of the links of the chain, to vary inclination as desired.

Alternatively the adjustable means consists of a step-by-step electric motor that by means of a kinematic device rotates, as comanded, the lid round its hinge until the desired inclination of the lid, and therefore of the photosensitive squared board, is achieved.

15 The step-by-step electric motor is operated by a button placed on one wall of the case.

Alternatively the step-by-step motor may be operated by one or more phototransistors, placed on the front of the case, which on receiving a ray of concentrated light, open the cover and establish
20 its desired inclination.

The emitter of concentrated light is placed in the centre of a frame of the type used for spectacles, or else is fixed close to the hinge of one of the usual ear pieces forming part of spectacle frames.

The ray of concentrated light may be a laser ray or some other.

25 Each phototransistor is preferably fitted with a converging lens.

In one type of execution a barrier is placed round the perimeter of the photosensitive squared board, said barrier consisting of a kind of rectangular frame comprising four tubes with longitudinal slits in them and having at each corner junction a pair of phototransistors
30 at 90° directed towards the two tubes that meet at the junction

When, on casually leaving the squared board, the laser beam

enters the slits, its light is diffused on the phototransistors that activate a circuit extinguishing the laser and simultaneously determining emission of a non-laser light from a device placed on the second earpiece of the 'spectacle' frames.

5 When said frames once more tend to coincide with the squared board, and still due to action of the non-laser light on the phototransistors through the slits in the tubes, a circuit is activated that turns on the laser again which then resumes its action on the phototransistors in the squared board.

10 It will be clear from the above, that the presence of this barrier automatically restricts action of the laser to the area of the photosensitive squared board which it cannot therefore leave.

The invention offers evident advantages.

The photosensitive 'keyboard' can be used by all who are deprived
15 of the use of their upper limbs and who therefore are unable to write or use a personal computer in the ordinary way.

The person so handicapped can use a personal computer making only natural head movements as the squares to be used are 'seen' by the laser beam from the emitter fitted to the spectacle frames.

20 These spectacle frames elegantly replace the rudimentary headset and are obviously more acceptable to a handicapped person as being closer to normality.

The squared board also works well with any concentrated light and therefore not necessarily requires a laser beam.

25 In this case the laser-extinguishing circuits and the peripheral sensors can be eliminated.

The barrier created by the four tubes with phototransistors placed round the photosensitive squared board prevent any risk of the laser beam striking a person instead of said board.

30 Characteristics and purposes of the disclosure will be made still clearer by the following examples of its execution illustrated by

diagrammatically drawn figures.

Fig. 1 Case-carried instrument with photosensitive squared board connected to an ordinary computer, perspective.

Fig. 2 Detail of the photosensitive squared board, plan view.

5 Fig. 3 Detail of an auxiliary keyboard connected to the photosensitive squared board, plan view.

Fig. 4 Diagram of electronic connections to the principal circuits of the instrument

Fig. 5 The instrument with its photosensitive squared board, connected to an ordinary computer, used by a handicapped person, perspective..

Fig. 6 Diagram of electronic connections to the photosensor in one square on the photosensitive squared board.

15 Figs 7 and 8 Executive electronic diagram of the photosensor in one square of the photosensitive squared board.

Fig. 9 Diagram of electronic connections to the dual action photosensor in one square on the photosensitive squared board.

Figs 10 and 11 Executive electronic diagram of the dual action photosensor in one square on the photosensitive squared board.

20 Fig. 12 The instrument closed in its case, perspective.

Fig. 13 Detail of the photosensitive squared board with a peripheral barrier and photosensors to prevent the laser beam from leaving the field of said board.

25 Figs 14 and 15 Executive electronic diagram of a photosensor in the barrier's peripheral circuit.

Figure 1 shows the instrument 10 with the photosensitive squared board 40, connectable to a personal computer 11 by the wire 12, standing in its case 20 with lid 30.

30 The lid 30, carrying the photosensitive squared board 40, is joined to the case 20 by hinges 21 and the chain 22, one end of which is fixed to the peg 31 on the lid and the other to the peg 23 on the

case so that, by moving one link or another of the chain on the peg fixed to the case, adjustment can be made of inclination of the lid in relation to the case and therefore to the handicapped person's head.

- 5 The photosensitive squared board 40 comprises a number of squares 41, 44 substantially corresponding to the keys of an ordinary electronic keyboard.

A central phototransistor 42 together with a green LED 43 may be seen in each square.

- 10 Any converging lenses present in each phototransistor can improve the precision of a laser beam.

On the upper surface 25 of the case 20 is a keyboard with a series of squares 27 substantially corresponding to the squares on the photosensitive squared board 40 in the lid 30, having keys 27

- 15 corresponding to those of an ordinary computer keyboard.

In the bottom of the case 20 is an electronic motherboard 50 the circuits of which substantially correspond to those for the keys of ordinary electronic keyboards, connectable to an ordinary computer by the wire 12.

- 20 Between the motherboard 50 and the keyboard 26 is a daughter board 51 having circuits and electronic components suitable for connecting the photosensitive squared board 40 and the mechanical keyboard 26 to the mother board 50.

- 25 A device substantially similar to frames 60 for spectacles, presents an emitter 70 of concentrated and precisely aimed light, a laser beam in this example, fitted at each hinge 61 of the ear pieces 65.

The emitter 70 can be connected to electric feed inside the instrument by the wire 62 and plug 63.

- 30 To work the computer, the handicapped person 15 puts on the frames 60, as shown in Figure 5, and then by head movement makes the laser beam 75 coincide with a phototransistor, such as

42, in the centre of a square corresponding to the desired key of the computer, such as square 44.

When the light beam 75 meets the phototransistor 42, the LED 43 shows a green light to confirm coincidence.

- 5 The effect of this coincidence, and through daughter and mother boards 51 and 50 and the cable 12, is to operate the computer 11 just as if the key corresponding to square 44 had been pressed.

Figure 5 shows, on the screen 13 of the computer 11, the letter 'e' 49 corresponding to square 44 whose phototransistor 42 has been
10 hit by the beam 75.

The operator can obviously move the laser beam onto the phototransistor of any square corresponding to the desired key of the computer 11.

- The keyboard 27, substantially equivalent to a normal computer
15 keyboard, serves to allow a helper to assist the handicapped person if necessary, especially in an experimental stage, and to correct any errors or overcome any difficulties.

Each phototransistor acts like an ordinary key of an electronic keyboard through the electronic circuit shown in Figure 6.

- 20 This figure shows the component 80 corresponding to the part sensitive to the laser beam, connected to a first comparator 81 to control permanence of said laser beam.

A second comparator 82, having a circuit able to determine passage of a single pulse, sends said pulse to the activating circuit
25 83 of a relay to close the circuit corresponding to the square in which there is the phototransistor concerned.

The pulse transmitted to said circuit 83 reaches the electronic motherboard 50 shown in Figure 1.

Figures 7 and 8 show one type of executive electronic diagram.

- 30 The diagram comprises two comparators and a double-acting relay. When the phototransistor FT1 is not hit by the laser beam, the

potential V (PIN 2) of U1 is greater than V (pin 3), while V (pin 1), being single feed, is equal to zero.

If FT1 is hit by the beam, V (pin 1) is worth about Vcc so that the condenser C1 begins to charge.

- 5 After about 0.5 of a second the VC1 will be greater than the voltage imposed by the divider R5-R6.

This time is needed to avoid any false steps due to exploration by the laser beam on the squared board.

- The condenser C2 will consequently charge and provide a pulse to
10 the base of the transistor TR1 long enough for activating the relay.
Presence of the R7 resistance ensures a rapid discharge of the condenser so that the transistor will immediately be locked.

The ultimate result is a single activation of the square even if the laser beam remains a long time on the phototransistor.

- 15 Alternatively the diagram in Figure 9 can be used where the element 90 sensitive to the laser is connected to a first comparator 91 to control how long the laser beam remains.

- A second comparator 92, with a monostable circuit for continuance of activation, transmits a single pulse to the activating circuit 93 of a
20 relay for determining closure of the electric circuit corresponding to the square in which the phototransistor is placed.

The pulse sent out by said circuit 93 reaches the motherboard 50 shown in Figure 1.

- Figures 10 and 11 show a type of actuation of the executive
25 diagram. The circuit is composed of two comparators, one monostable and one double-acting relay.

If the phototransistor FT1 is not hit by the laser beam the potential V (PIN 2) of U1 is greater than V (pin 3) and, feed being single, the V(pin1) is equal to zero.

- 30 If FT1 is hit by the beam then V (pin1) is worth about Vcc so that the condenser C1 begins to charge.

After about 0.5 of a second the VC1 will be greater than the voltage imposed by the divider R5-R6.

This length of time is needed to avoid false steps due to exploration of the laser beam on the squared board.

- 5 The condenser C2 will consequently charge generating a rising edge on the input of the trigger of the monostable circuit U2.

In this condition the monostable is not yet activated.

- From the moment the beam is turned off, the condenser C2 will discharge generating a trailing edge suitable for activating the
10 monostable circuit.

There is nothing casual about this expedient because duration of the timer is fully exploited as interruption of the beam coincides with search of the operating or controlling phototransistor.

- Voltage level on foot 3 of U2 brings the transistor TR1 to saturation
15 actuating the relay for closure of contacts corresponding to the desired square on the squared board and turning on the LED.

The monostable remains active for about 10 seconds sufficient for selection of the other phototransistors.

- Figure 12 shows the instrument when closed, with the lid shut down
20 on the case.

The handle 24 provides a convenient means for carrying it.

- Figure 13 gives a detailed view of the inside of the lid 30 of the instrument, clearly showing the four metal tubes 47 placed round the photosensitive squared board 40, with their longitudinal slits 48
25 facing towards said board, together forming a sort of rectangle.

A pair of phototransistors 54, 55, each respectively turned towards the tubes terminating at a junction, are placed at said junction 53.

- If, on leaving the squared board 40, the laser beam by chance enters the slits 48 in the tubes, its light is diffused and is picked up
30 by the phototransistors 54 and 55 placed at either end of each tube.

These phototransistors act on special circuits that extinguish the

laser and at the same time turn on a non-laser light emitted by a device on the second earpiece of the spectacle frame 60.

When the frame returns to the position coinciding with the squared board 40, said non-laser light acts once more on the phototransistors 54 and 55 lighting up the laser again through a specially made circuit.

The barrier formed by the above four tubes, stops the laser from being directed onto anyone outside the squared board 40.

Figures 14 and 15 show an executive diagram of one of the peripheral sensors already described.

The laser beam can obviously be relaced by a beam from another type of concentrated light.

Claims

1. Instrument (10) for generating controls to a computer (11) equivalent to those generated by the keys of an ordinary keyboard, characterized in that it comprises a squared board (40) the squares
5 (41) of which correspond to the keys of an ordinary keyboard of a computer, each key being provided with a phototransistor (42) that by means of electronic circuits (80-83, 90-93, 50) transmits to the computer 11 pulses equivalent to those it would receive by pressure on the key corresponding to said square (41, 44) as soon as said
10 phototransistor (42) receives a beam (75) of concentrated light from an emitter (70) fixed to a device (60) of a structure similar to spectacle frames, worn on the head of a handicapped person (15).
2. Instrument (10) for generating controls equivalent to those generated by the keys of ordinary keyboards, as in claim 1,
15 characterized in that in each square (41, 44), there is a coloured LED (43) that lights up when the beam (75) of concentrated light coincides with the phototransistor (42) informing the handicapped person (15) that the pulse has been duly given.
3. Instrument (10) for generating controls equivalent to those generated by the keys of ordinary keyboards, as in claim 1,
20 characterized in that the circuits (80-83, 90-93, 50) comprise an electronic motherboard (50) equivalent to that associated to the keys on the ordinary keyboard of a computer (11), electronically connected upstream to the photosensitive squared board (40) and
25 downstream to the computer (11).
4. Instrument (10) for generating controls equivalent to those generated by the keys of ordinary keyboards, as in claim 3,
characterized in that between the electronic motherboard (50) and the photosensitive squared board (40) is an electronic daughter
30 board (51) on which are the circuits (80-83, 90-93) needed for generating signals between the various phototransistors (42) placed

in the squares (41, 44) of the photosensitive squared board (40) and the circuits of the computer (11) corresponding to the keys of ordinary keyboards.

- 5 5. Instrument (10) for generating controls equivalent to those generated by the keys of ordinary keyboards, as in claim 1, characterized in that associated to the photosensitive squared board (40) is an auxiliary keyboard (26) substantially equivalent to the ordinary keyboards for computers, in which each key (27) is electronically connected both to the photosensor (42) in a square
10 (41, 44) of the photosensitive squared board (40) and to the electronic circuits (80-83, 90-93, 50) that transmit the pulses to the computer (11) the purpose of this being to permit a helper of the handicapped person (15), especially in the learning stages, to correct any errors or overcome difficulties.
- 15 6. Instrument (10) for generating controls equivalent to those generated by the keys of ordinary keyboards, as in claims 1, 3, 4, 5, characterized in that structurally it is composed of a case (20) with a lid (30), the auxiliary keyboard (26) being placed on the upper surface (25) of the case (20) and, in the lid (30), the photosensitive
20 squared board (40) while the mother and daughter boards (50, 51) with the circuits (80-83, 90-93) needed for connecting up to the computer (11) are placed inside the case (20).
- 25 7. Instrument (10) for generating controls equivalent to those generated by the keys of ordinary keyboards, as in claims 1 and 6, characterized in that the lid (30) of the instrument (10) is hinged (21), in relation to the case (20), on one of its long sides so that the photosensitive squared board (40), situated inside said lid (30), can be inclined in relation to the upper surface (25) of the case (20) as preferred and made stable by an adjustable means.
- 30 8. Instrument (10) for generating controls equivalent to those generated by the keys of ordinary keyboards, as in claim 7,

characterized in that the adjustable means consists of a chain one end of which is attached to a pin (31) on the lid (30) and the other to a pin (23) on the side of the case (20) close to its upper edge, it being thus possible, by inserting said latter pin (23) in one link or another of the chain (22), to vary inclination and fix it as required.

9. Instrument (10) for generating controls equivalent to those generated by the keys of ordinary keyboards, as in claim 7, characterized in that the adjustable means consists of a step-by-step electric motor which, with a kinematic device, determines rotation, as commanded, of the lid (30) round its hinge (21) until the desired inclination is reached by said lid (30) and therefore by the photosensitive squared board (40).

10. Instrument (10) for generating controls equivalent to those generated by the keys of ordinary keyboards, as in claims 6 and 9, characterized in that the step-by-step electric motor is worked by a push button placed on one side of the case (20) containing the instrument (10).

11. Instrument (10) for generating controls equivalent to those generated by the keys of ordinary keyboards, as in claims 6, 9 and 10, characterized in that the step-by-step electric motor is worked by one or more phototransistors placed on the front of the case (20) and these, on receiving a beam of concentrated light, open the lid (30) and fix it at the desired inclination.

12. Instrument (10) for generating controls equivalent to those generated by the keys of ordinary keyboards, as in claim 1, characterized in that the emitter (70) of a beam (75) of concentrated light is placed in the centre of a pair of spectacle frames.

13. Instrument (10) for generating controls equivalent to those generated by the keys of ordinary keyboards, as in claim 1, characterized in that the emitter (70) of a beam (75) of concentrated light is fixed to an ordinary pair of frames (60) for spectacles, close

to the hinges (61).

14. Instrument (10) for generating controls equivalent to those generated by the keys of ordinary keyboards, as in claim 1, characterized in that the beam (75) of concentrated light is a laser.

5 15. Instrument (10) for generating controls equivalent to those generated by the keys of ordinary keyboards, as in claim 1, characterized in that each phototransistor (42) is fitted with a converging lens.

16. Instrument (10) for generating controls equivalent to those generated by the keys of ordinary keyboards, as in claims 1, 13 and 14,
10 characterized in that, round the peripheral edge of the photosensitive squared board (40) is a barrier formed of a kind of rectangular frame consisting of four tubes (47) in each of which is a longitudinal slit (48) facing towards the squared board, and at each of the four
15 junctions (53) formed by the four tubes (47) there is a pair of phototransistors (55) placed at 90° facing towards the two tubes (47) that terminate at the junction (53), a circuit being activated, should the laser beam (75) casually leave the squared board (40) and, entering the slit (48), hit the phototransistor (55), which
20 extinguishes the laser (55) and at the same time turns on a non-laser light emitted by a device placed on the second earpiece of the spectacle frames (60), said non-laser light, when the frames (60) once more tend to coincide with the squared board (40), similarly acting through the slits (48) in the tubes (47) on the phototransistor
25 (55) activating a circuit that turns on the laser (75) permitting resumption of its action on the phototransistor (42) on the squared board (40)

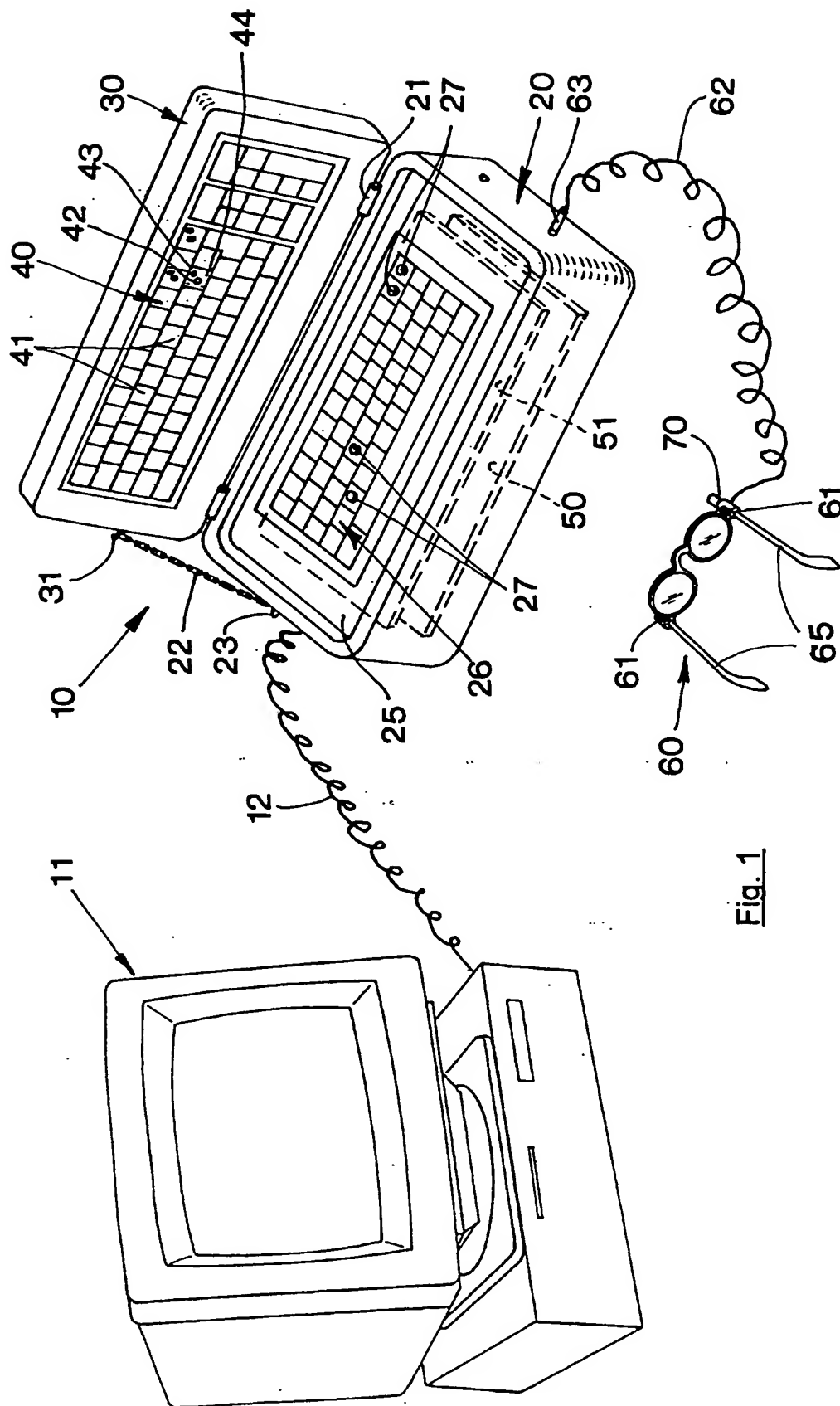


Fig. 1

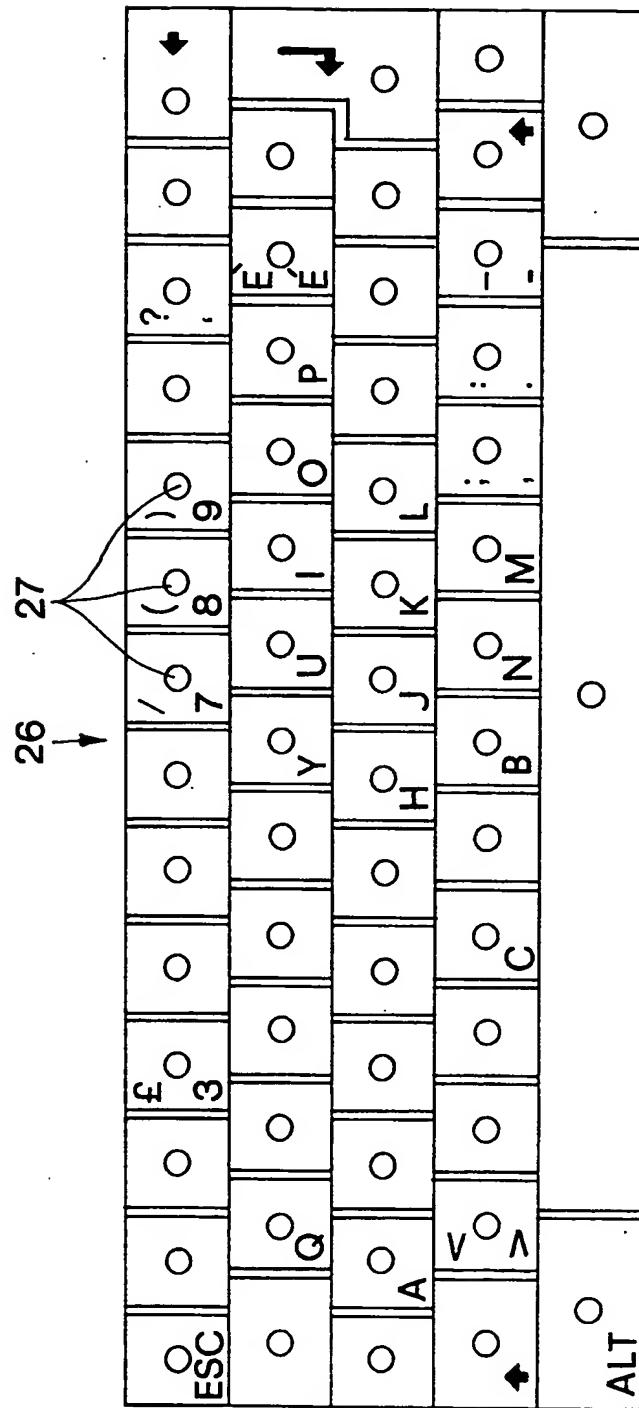


Fig. 2

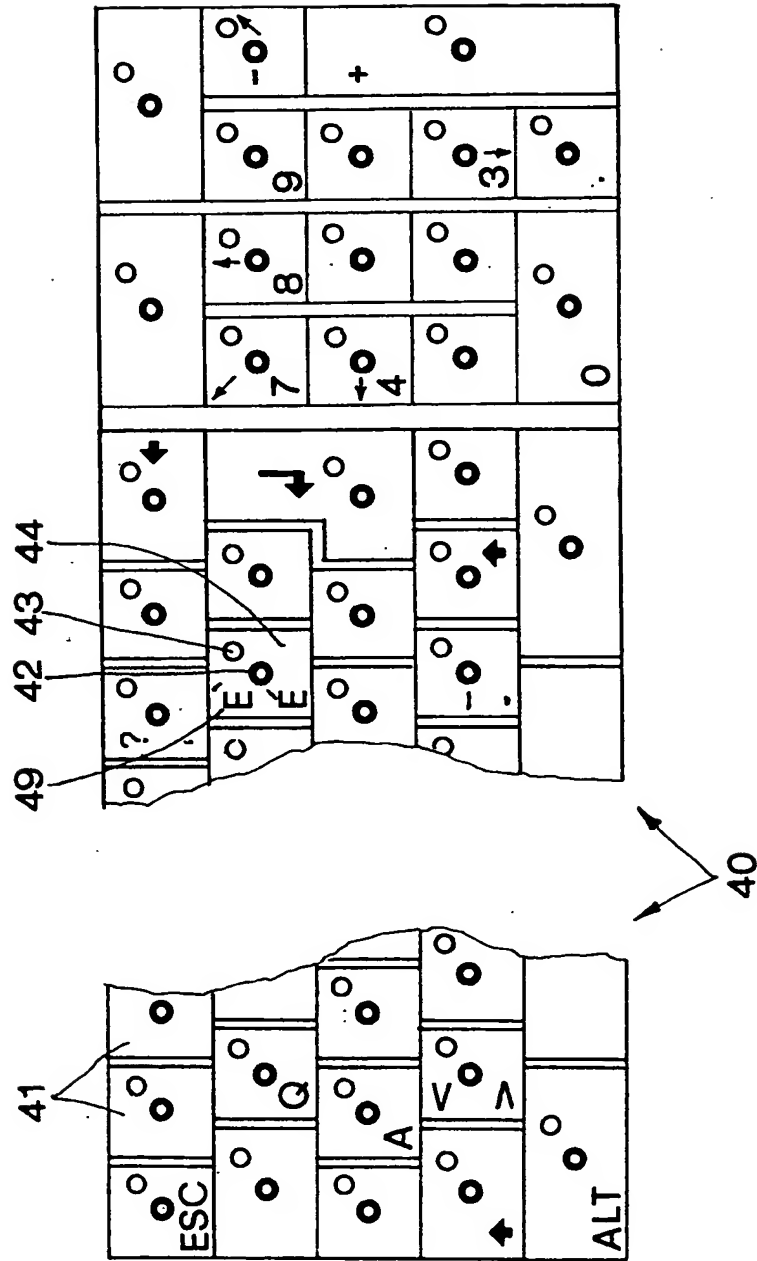


Fig. 3

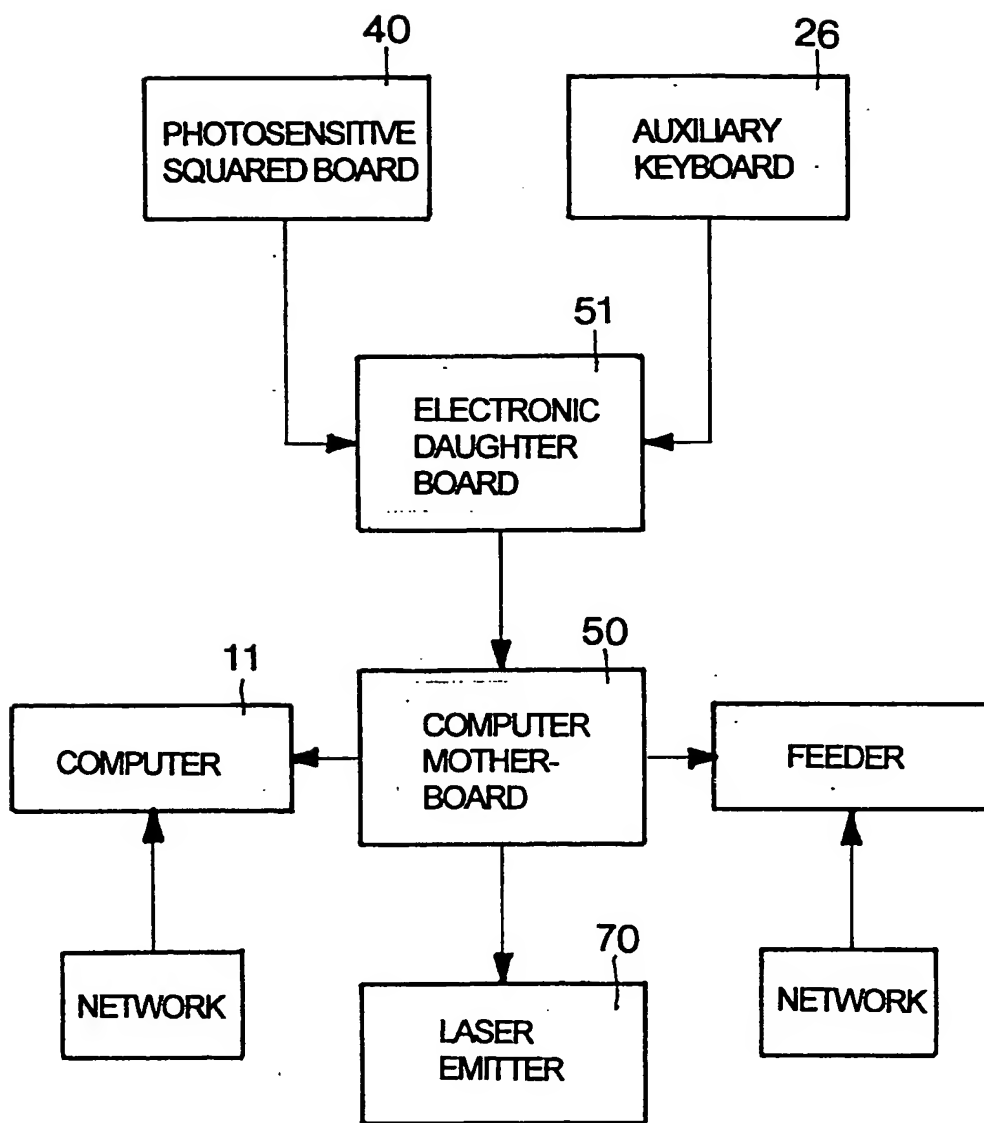
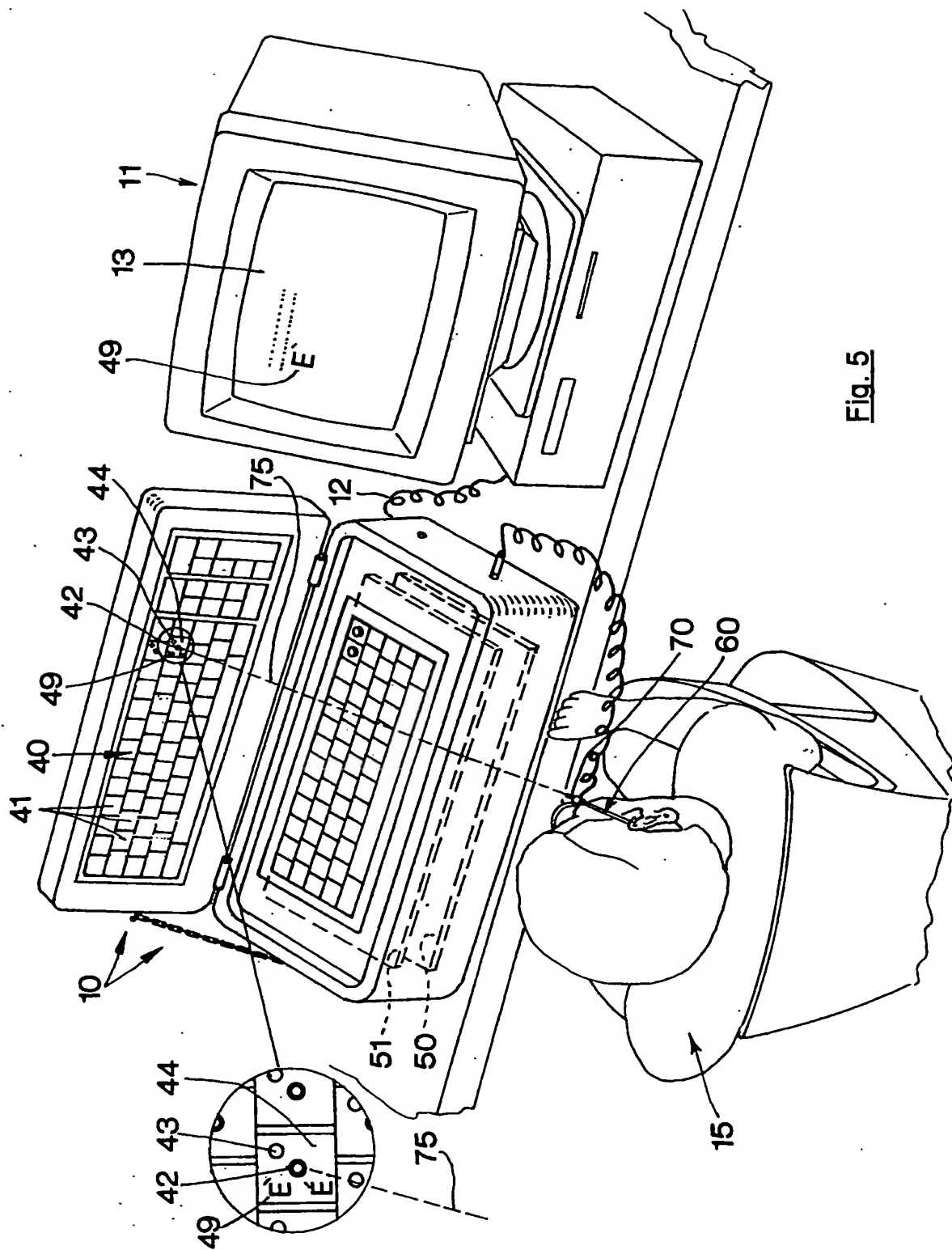


Fig. 4



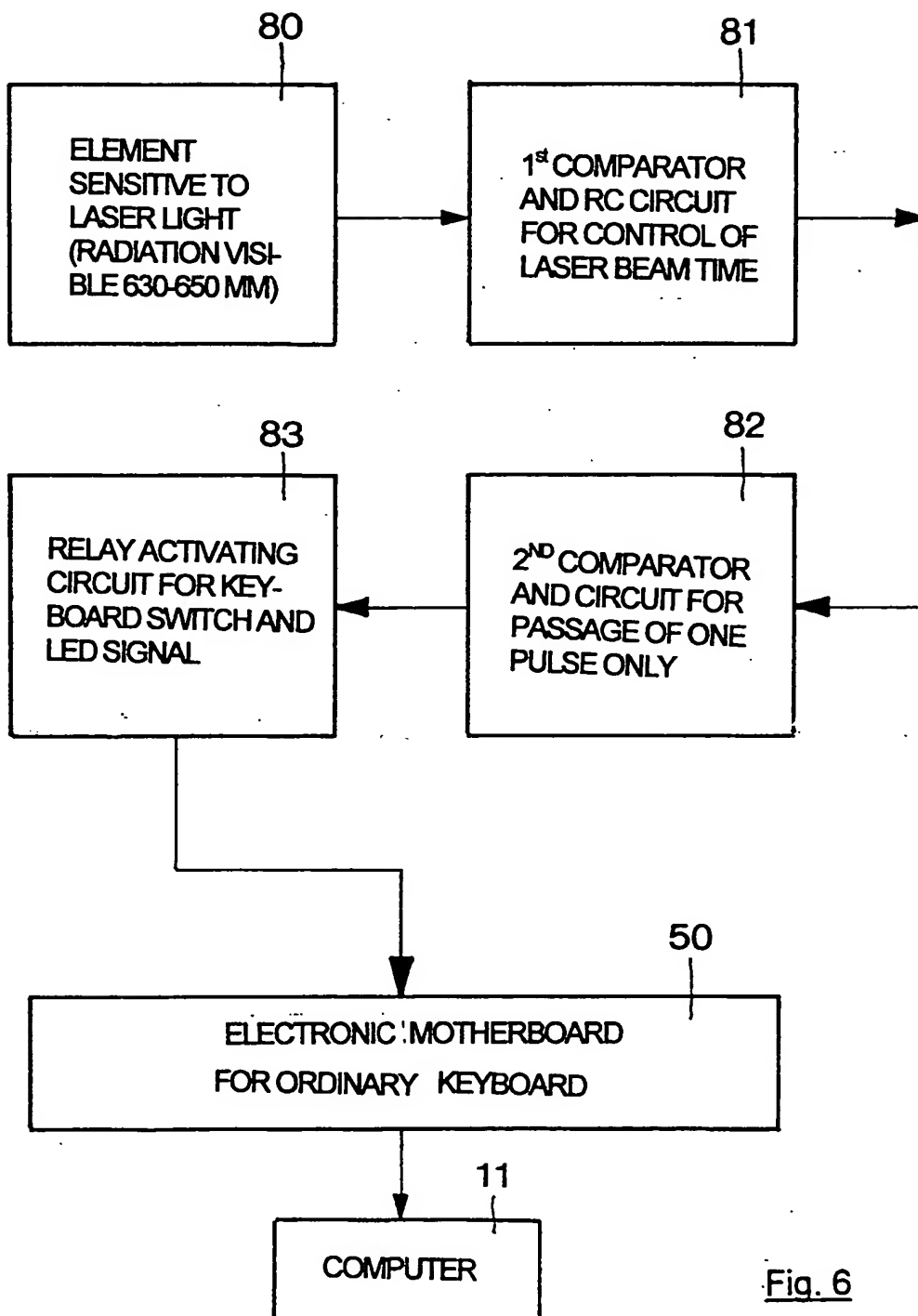


Fig. 6

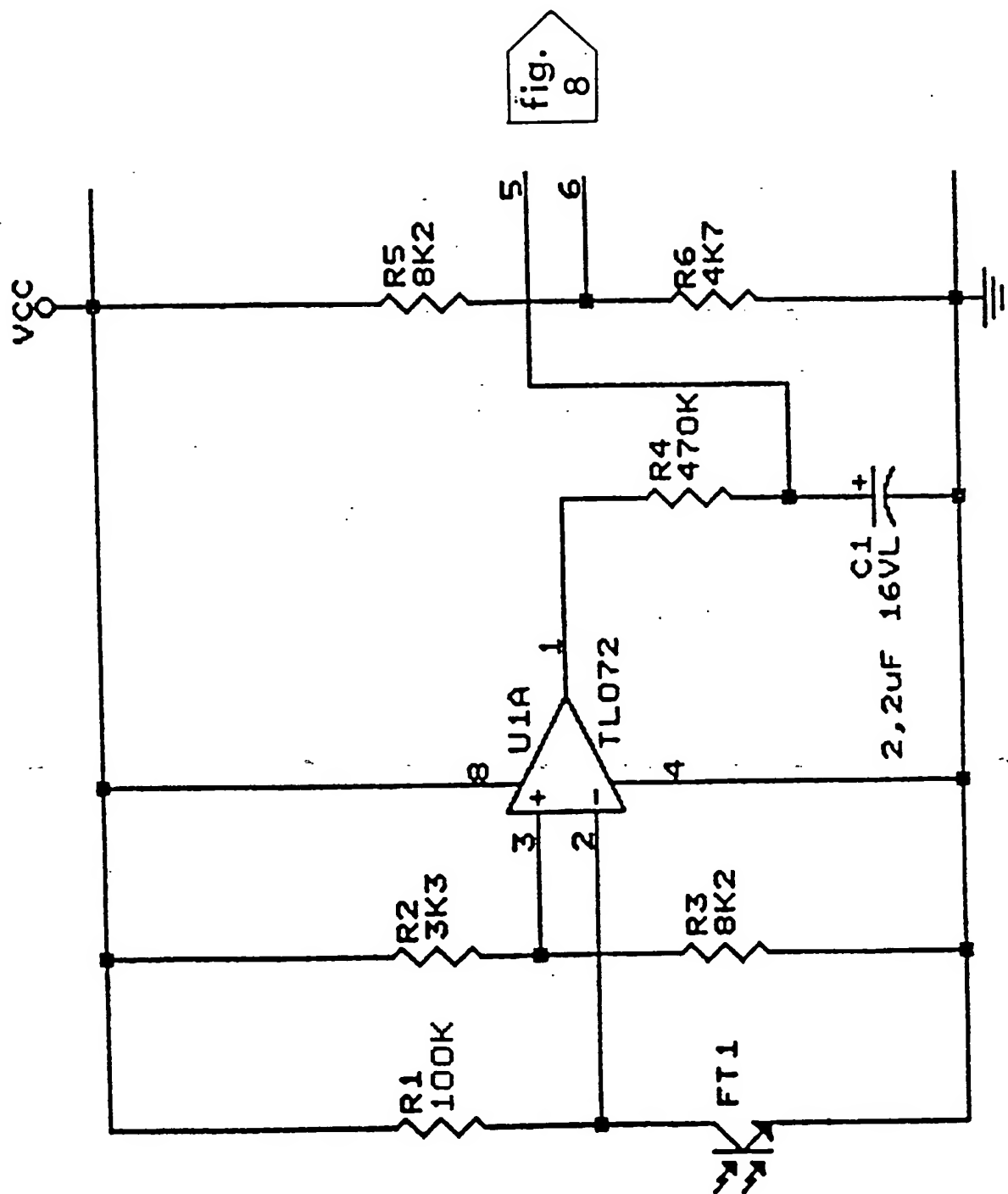


Fig. 7

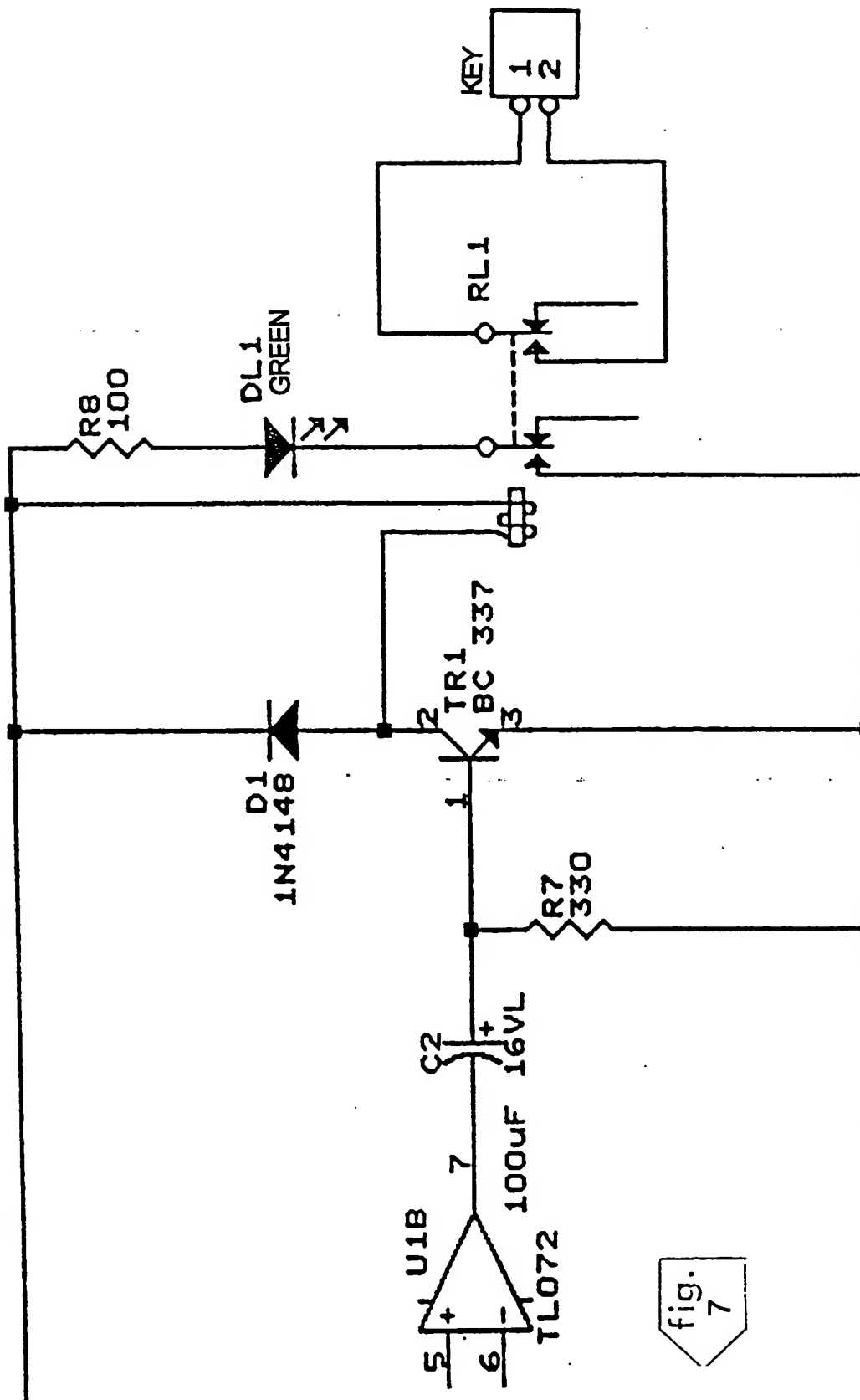


Fig. 8

fig.
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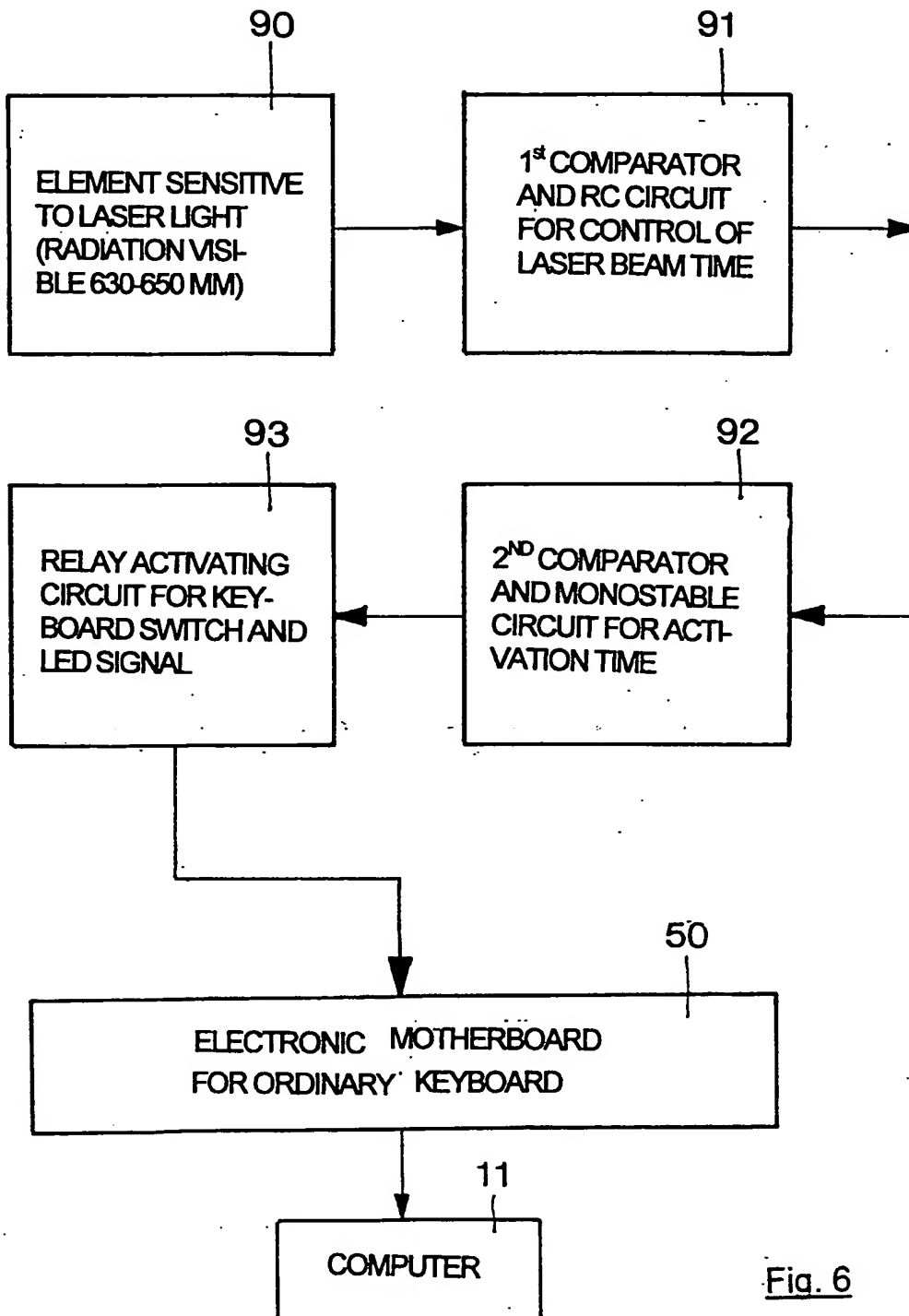


Fig. 6

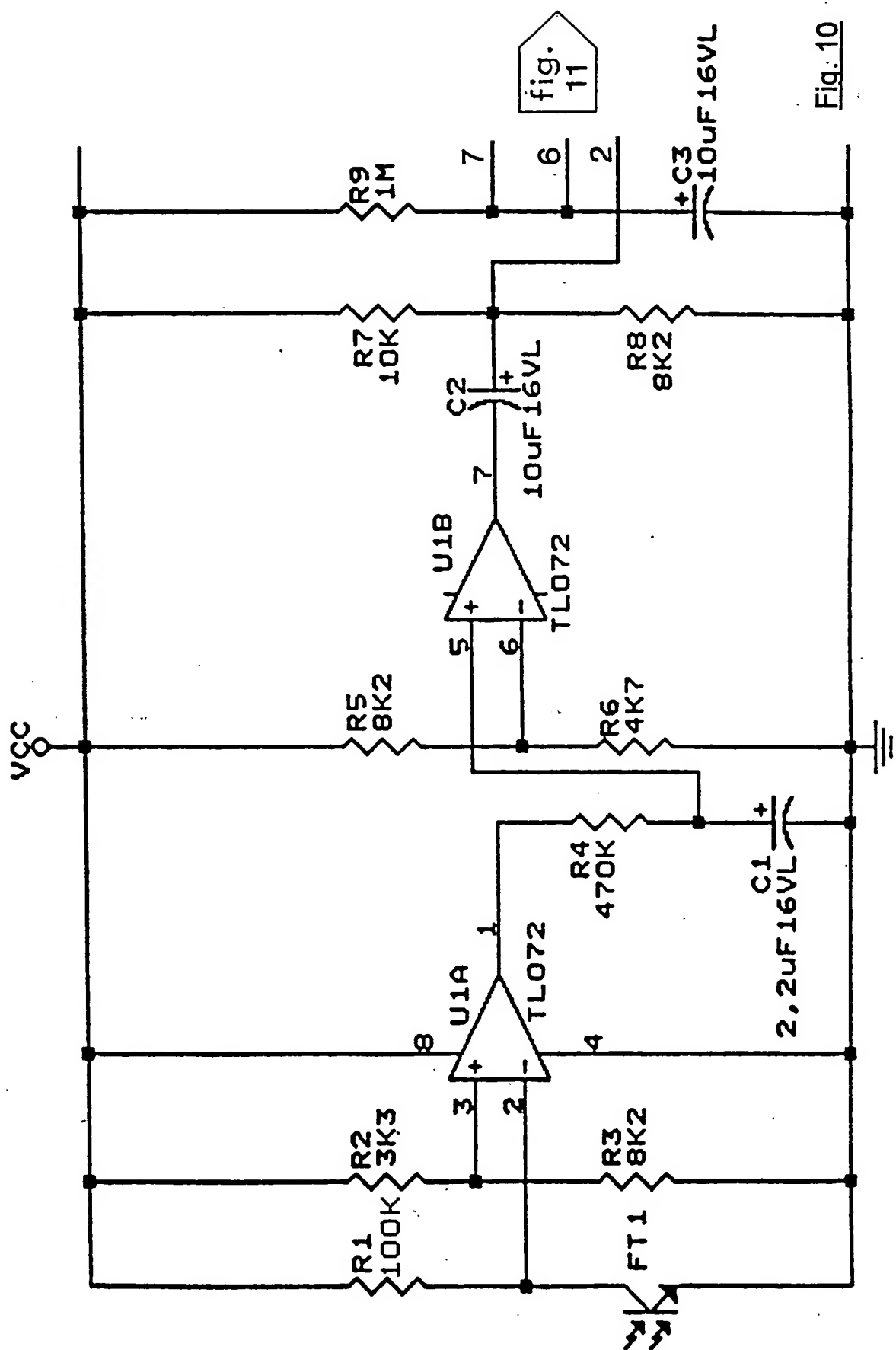


Fig. 10

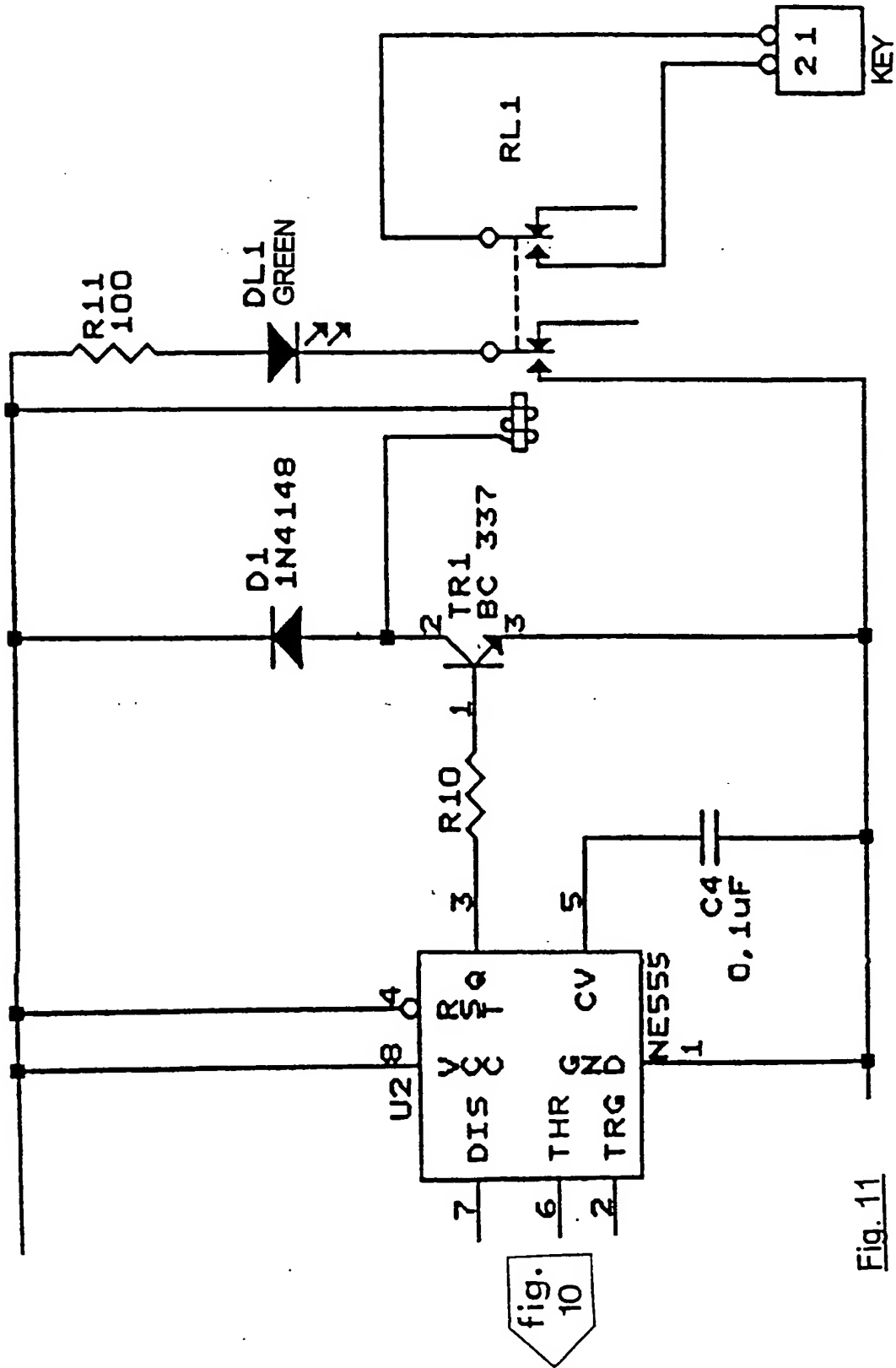


Fig. 11

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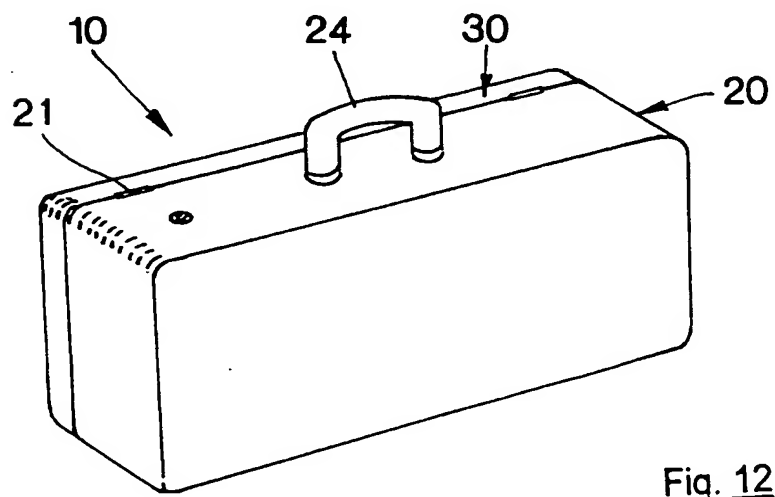
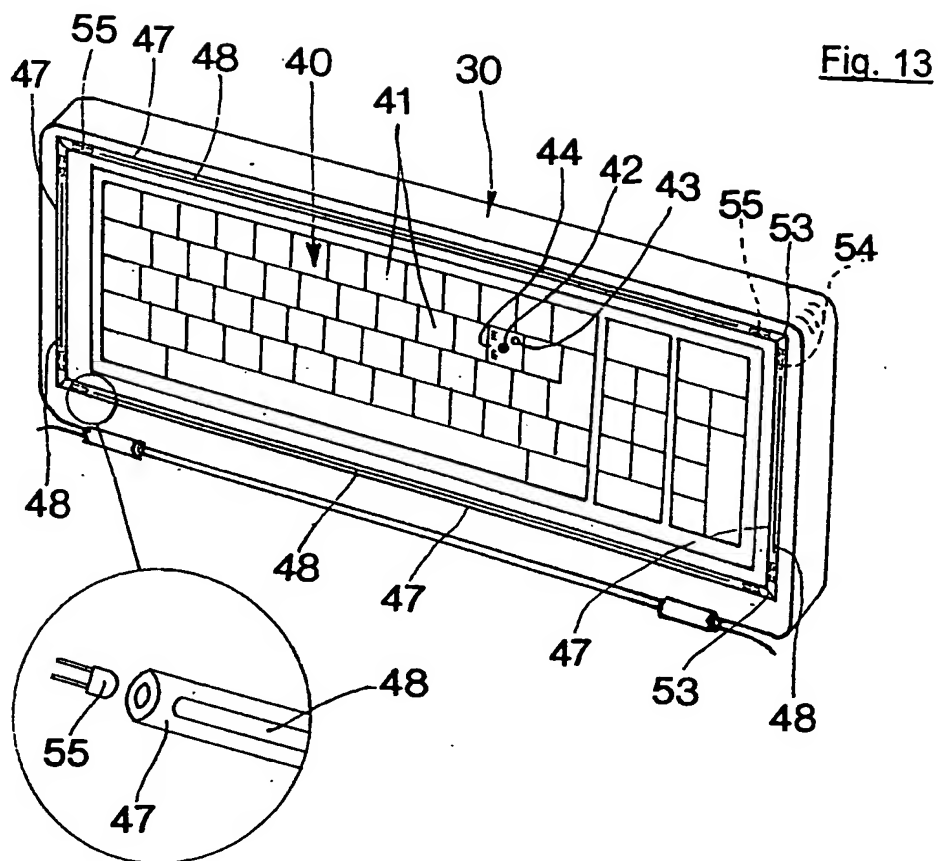


fig.
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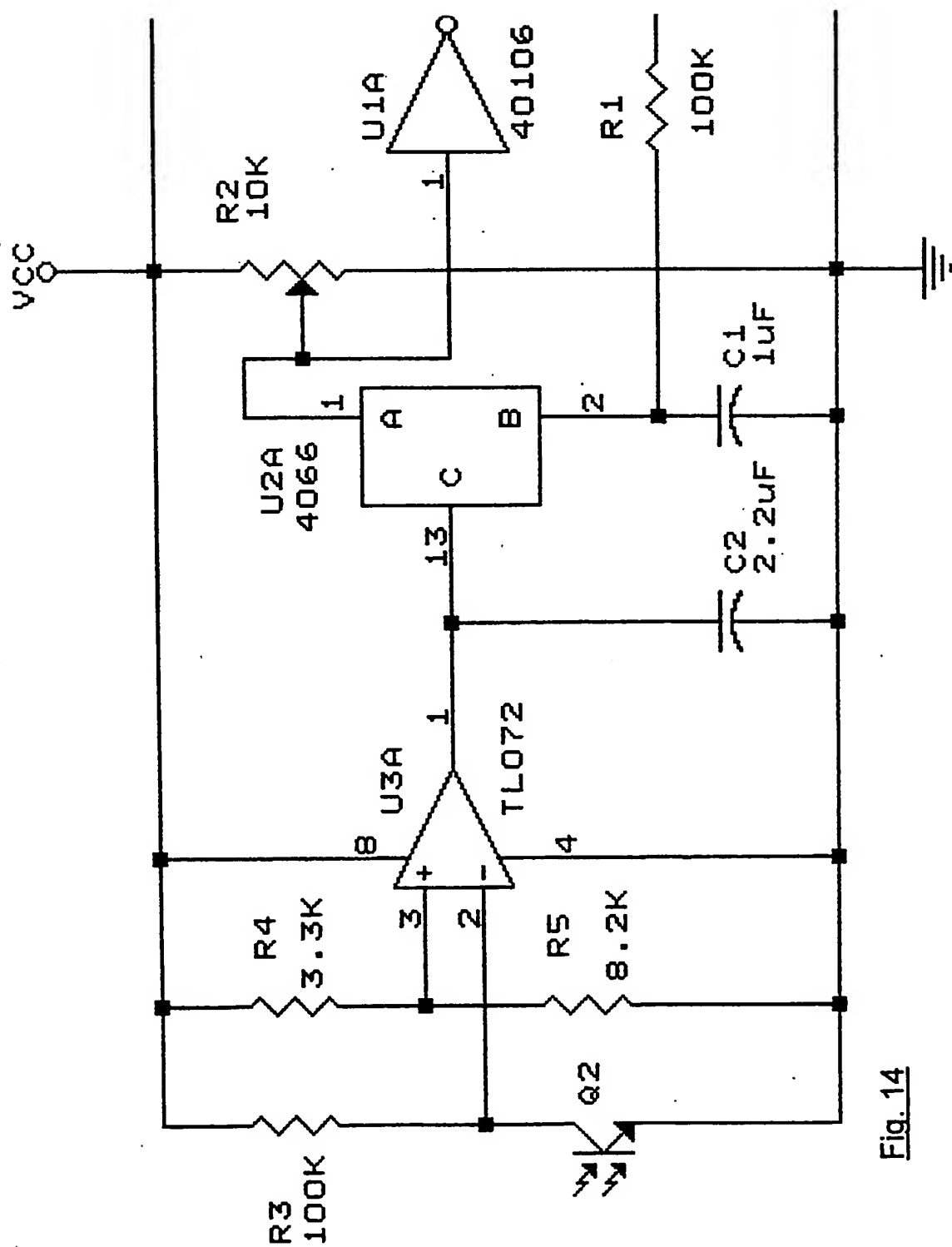


Fig. 14

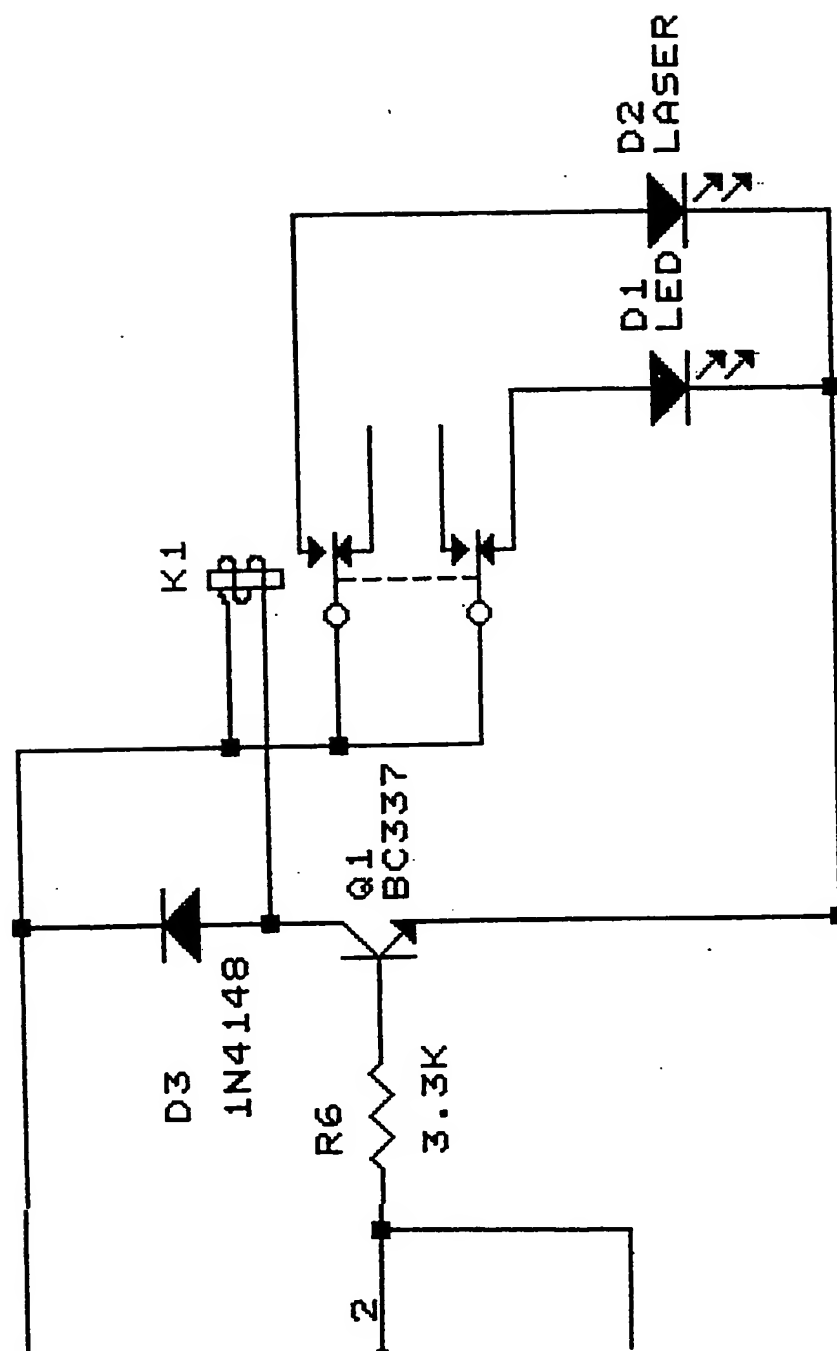


fig.
14

Fig. 15

INTERNATIONAL SEARCH REPORT

International Application No

PCT/IT 99/00107

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 G06F3/023 G06F3/00 G09B21/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G06F G09B G06K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0 836 150 A (MAJED EL MARRI SAQR) 15 April 1998 (1998-04-15) column 1, line 22 -column 2, line 13 column 3, line 10 -column 4, line 8	1-4, 12-14
Y	WO 98 18100 A (MONGARLI ALESSANDRO ;ZANGIROLAMI MARCO (IT); PISANI MARCO (IT); EU) 30 April 1998 (1998-04-30) page 27, line 22 -page 28, line 13; figures 9,10	1-4, 12-14
A	US 4 713 535 A (RHOADES RANDY L) 15 December 1987 (1987-12-15) column 5, line 33 -column 6, line 45 column 8, line 6 - line 18 column 11, line 24 - line 36 -/-	1,2,14



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents:

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Date of the actual completion of the International search

17 December 1999

Date of mailing of the International search report

11/01/2000

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Bailas, A

INTERNATIONAL SEARCH REPORT

International Application No

PCT/IT 99/00107

C. (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>"COMPUTER PERIPHERAL SUPPORTING THE USE OF MULTIPLE KEYBOARDS"</p> <p>IBM TECHNICAL DISCLOSURE BULLETIN, US, IBM CORP. NEW YORK,</p> <p>vol. 39, no. 1, page 161-162 XP000556357</p> <p>ISSN: 0018-8689</p> <p>the whole document</p>	5
A	<p>DE 40 08 743 A (SCHATZ VIKTOR DIPL ING)</p> <p>26 September 1991 (1991-09-26)</p> <p>column 1, line 49 -column 2, line 9</p>	5

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/IT 99/00107

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0836150	A	15-04-1998	NONE	
WO 9818100	A	30-04-1998	IT T0960848 A AU 4012697 A EP 0932878 A	17-04-1998 15-05-1998 04-08-1999
US 4713535	A	15-12-1987	NONE	
DE 4008743	A	26-09-1991	NONE	